

Applicant : Bennett et al.  
Serial No. : 09/975,196  
Filed : October 10, 2001  
Page : 2 of 22

Attorney's Docket No.: 05542-480001 / 5758/CMP

Amendments to the Specification:

Please replace the title with the following title:

-- CARRIER HEAD VIBRATION ~~DAMPENING~~ DAMPING--

Please replace paragraph page 2, line 12 with the following paragraph:

--Implementations of the invention may include one or more of the following features. The portion of the base may be a ring-shaped body extended around a perimeter of the base. A ~~dampening~~damping material may be secured between the retainer and the portion of the base. At least one screw may extend through apertures in the base, the ring-shaped body and the damping material and into a receiving recess in the retaining ring to secure the retaining ring to the base. The ring-shaped body may include at least one boss extending to contact the retaining ring, and the boss may surround the screw. The polymer may include polyphenylenesulfide, carbon fibers and polytetrafluoroethylene, e.g., about 50-55%, 30-35%, and 10-15% respectively. The damping material may includes a polyvinylchloride thermoplastic. The entire base may be formed from the polymer. A bottom portion of the retainer may include at least one of carbon, fluoropolymer, and polyester.--

Please replace paragraph page 2, line 24 with the following paragraph:

--In another aspect, the invention is directed to a carrier head for chemical mechanical polishing that has a base, a mounting assembly attached to the base having a surface for contacting a substrate, a retainer secured to the portion of the base to prevent the substrate from moving along the surface, and a ~~dampening~~damping material secured between the retainer and the base.--

Please replace paragraph page 2, line 29 through Page 3, line 4, with the following:

Applicant : Bennett et al.  
Serial No. : 09/975,196  
Filed : October 10, 2001  
Page : 3 of 22

Attorney's Docket No.: 05542-480001 / 5758/CMP

--Implementations of the invention may include one or more of the following features. The ~~dampening~~damping material may include at least one of polyurethane and polyvinylchloride thermoplastic. At least a portion of the base may be formed of a polymer and the retainer may be secured to the portion of the base. The portion of the base may be a ring-shaped body extended around a perimeter of the base. At least one screw may extend through apertures in the base, the ring-shaped body and the damping material and into a receiving recess in the ~~retaining-ringretainer~~ to secure the ~~retaining-ringretainer~~ ring to the base. The ring-shaped body may include at least one boss surrounding the screw and extending to contact the ~~retaining-ringretainer~~. A bottom portion of the retainer may include at least one of carbon, fluoropolymer, and polyester.--

Please replace paragraph page 3, line 24 will the following paragraph:

--In another aspect, the invention is directed to an article for attachment to a carrier head that has a generally flat annular body configured to be detachably secured at an outer perimeter of a carrier head. The annular body is formed of a ~~dampening~~damping material and has a plurality of apertures therethrough.--

Please replace paragraph page 3, line 28 will the following paragraph:

--In an implementation of the invention, the ~~dampening~~damping material may include at least one of polyurethane and polyvinylchloride thermoplastic.--

Please replace paragraph page 8, line 18 through Page 9, line 6, with the following:

--A second implementation includes the damping material in the retaining ring itself. Referring to Fig. 3, the annular retaining ring 110 includes four portions, which are stacked one on top of another. An upper portion 203 and a middle portion 184 of the retaining ring 110 are ~~[[a]]~~ rigid rings. For example, the upper portion 203 can be a stainless steel ring with a thickness of about 0.1 inches, and the middle portion 184 can be a stainless steel ring with a thickness of about 0.25 inches. The upper portion 203 is

Applicant : Bennett et al.  
Serial No. : 09/975,196  
Filed : October 10, 2001  
Page : 4 of 22

Attorney's Docket No.: 05542-480001 / 5758/CMP

attached to the middle portion 184 through a damping material 200, which is similar in thickness and is made from the same material as the damping material 230 of Fig. 2. The damping material 200 reduces or prevents the transmission of vibration energy from the middle portion 184 to the upper portion 203. Pressure sensitive adhesive 202 adheres the damping material 200 to the upper portion 203, while pressure sensitive adhesive 201 adheres the damping material 200 to the middle portion 184. The lower portion 180 is a relatively softer material that is chemically inert in the polishing process, such as polyphenylene sulfide (PPS), available from DSM Engineering Plastics of Evansville, Indiana. The lower portion 180 can be is-durable but gradually wears away with use. The lower portion 180 has a bottom surface 182, which contacts the polishing pad 32 during polishing. The bottom surface can have substantially radial grooves (not shown) for transporting slurry from the outside of the retaining ring to the surface of the substrate 10. The middle portion 184 can ~~add~~add rigidity to the lower portion 180, thereby reducing the deformation of the retaining ring during polishing. The middle portion 184 can be secured to the lower portion 180 by a layer of epoxy adhesive 186, such as Magnobond-6375TM, available from Magnolia Plastics of Chamblee, Georgia.--

Please replace paragraph page 9, line 7 with the following paragraph:

--The thickness ~~[[TL]]~~ of the lower portion 180 should be larger than the thickness TS of the substrate 10. Specifically, the lower portion 180 should be thick enough that the substrate 10 does not contact the adhesive layer 186. On the other hand, if the lower portion 180 is too thick, the bottom surface 182 of the retaining ring 110 may be subject to deformation due to the flexible nature of the lower portion 180. The initial thickness of the lower portion is typically between 200 to 400 mils. The lower portion 180 is replaced when the remaining thickness of the retaining ring is about the same as the thickness of the substrate.--

Applicant : Bennett et al.  
Serial No. : 09/975,196  
Filed : October 10, 2001  
Page : 5 of 22

Attorney's Docket No.: 05542-480001 / 5758/CMP

Please replace paragraph page 10, line 1 with the following paragraph:

--A layer or gasket of a ~~dampening~~damping material 304 is positioned between the retaining ring and the base 306 of the carrier head 300 to absorb and dissipate vibrational energy. The ~~dampening~~damping material can be a polyurethane foam or a polymeric material. Composites. Depending on the polishing conditions, a minimum thickness may be required for the gasket 304. The damping material can be a polyvinylchloride thermoplastic, such as Isodamp C-1002, available from EAR Specialty. In this case, the damping material should be precompressed by about 5-15% in thickness.--

Please replace paragraph page 10, line 9 with the following paragraph:

--In addition, a portion 308 of the base to which the retaining ring is attached is formed from a polymer material. For example, a ring-shaped insert 308 may be placed between the base 306 and the ~~dampening~~damping material 304. The retaining ring ~~[[306]]302~~ can be secured to the base 306 by inserting screws or bolts through the holes 318 in the insert 308 and gasket 304 into the upper layer 316 of the retaining ring. The ring-shaped insert 308 can have bosses around each screw. The tops of the bosses can contact the top surface of the upper portion 316 of the retaining ring. The bosses can control the amount of compression of the damping material and can secure the screws to ensure a tight connection between the base 306 and the retaining ring 300. The polymer material can be a mixture of polyphenylenesulfide (PPS), carbon fibers and polytetrafluoroethylene, e.g., 50-55%, 30-35%, 10-15% by weight, respectively.--

Please replace paragraph page 10, line 23 with the following paragraph:

--An edge of a flexible membrane 314 can be clamped directly between the upper surface of the retaining ring 302 and the base 306 as illustrated in Fig.5. Alternatively the flexible membrane can be clamped between the ~~dampening~~damping

Applicant : Bennett et al.  
Serial No. : 09/975,196  
Filed : October 10, 2001  
Page : 6 of 22

Attorney's Docket No.: 05542-480001 / 5758/CMP

material 304 and the base 306, or the flexible membrane 314 can be clamped between the retaining ring 302 and the ~~dampening~~damping material 304, or the flexible membrane could be attached in another fashion to the retaining ring, the base, or to another section of the carrier head.

Please replace paragraph page 11, line 30 with the following paragraph:

--For a working example, a carrier head according to Fig. ~~[[4]]~~5 was constructed using a gasket 308 composed of Isodamp C-1002 having a thickness of 60 mils, a ring-shaped insert 308 about 280 mils thick (including bosses which were about 56 mils tall) composed of a composite material with about 50-55% PPS, 30-35% carbon fiber, and 10-15% Teflon®, a stainless steel upper portion 316, and a PPS lower portion 310. The construction demonstrated reduced noise during copper polishing, using an applied pressure of 6 psi on the polishing pad from the substrate membrane, an applied pressure of 2.2 to 5.8 psi on the polishing pad from the retaining ring, and simultaneous conditioning.--

Please replace paragraph page 12, line 32 to page 13, line 6 with the following paragraph:

-- The middle portion 184 and the upper portion 203 (Fig. 3[[A]]) of the retaining ring maybe manufactured from aluminum or any other material that provides a suitable amount of stiffness to the retaining ring. The thickness of the middle portion 184 and the upper portion 203 may be varied, although if the middle and upper portions are too thin, the retaining ring may deform and reduce the quality of polishing. Alternatively, the middle portion 184 and the lower portion 180 (Fig. ~~3A~~Fig. 3) of the retaining ring 110 may be one integrated piece formed from the same kind of material, e.g., PPS or stainless steel. Other adhesive or attachment methods known to persons of skill may be used to affix the damping material.--